First Look at Pixel Endcap Cosmic Data

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SLAC ATLAS Forum, 10-Jan-2007

Outline

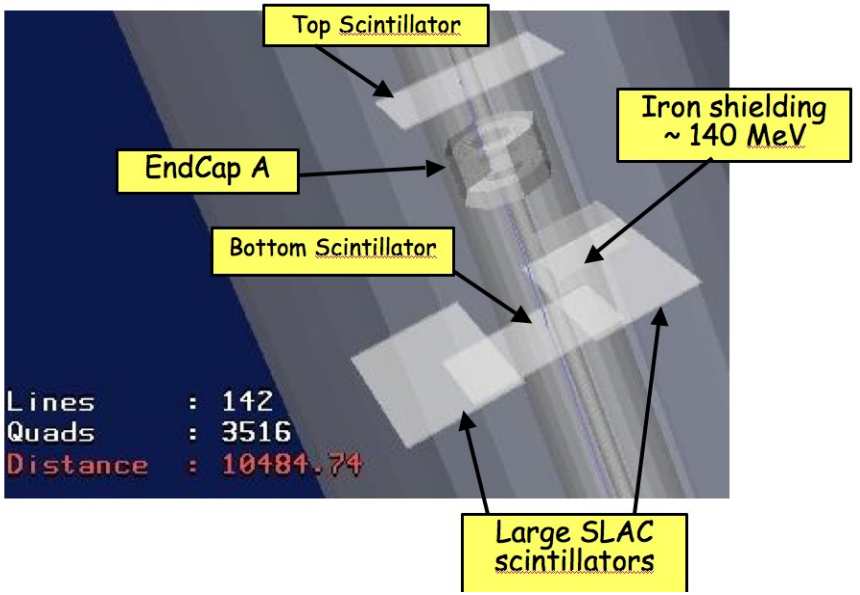
- Occupancy and noise studies.

- Clustering studies.
  effect of hot pixels.

- Tracking studies.
  - Tuning with data.
  - New geometry.

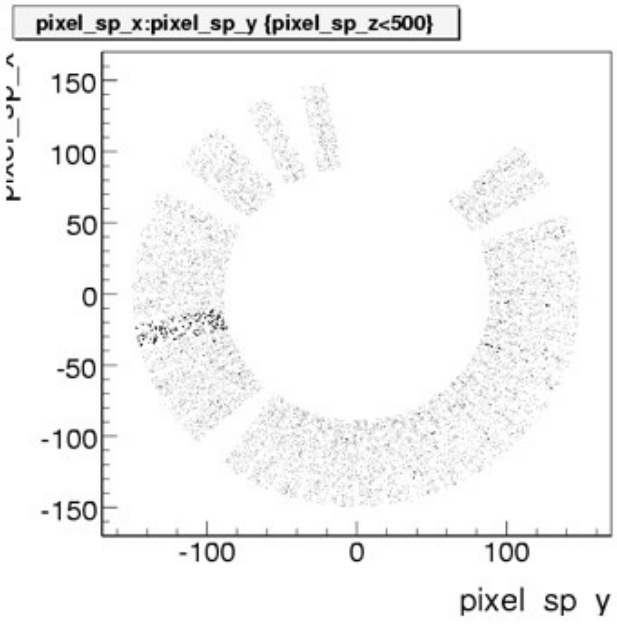
- Module efficiency.

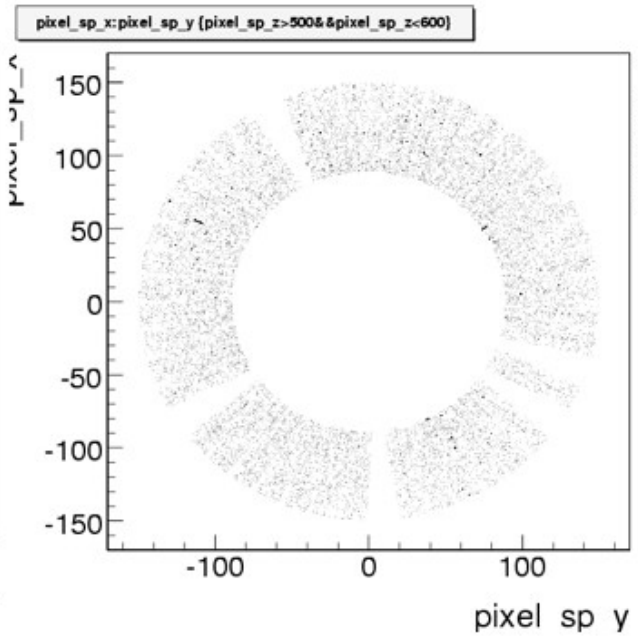
Introduction

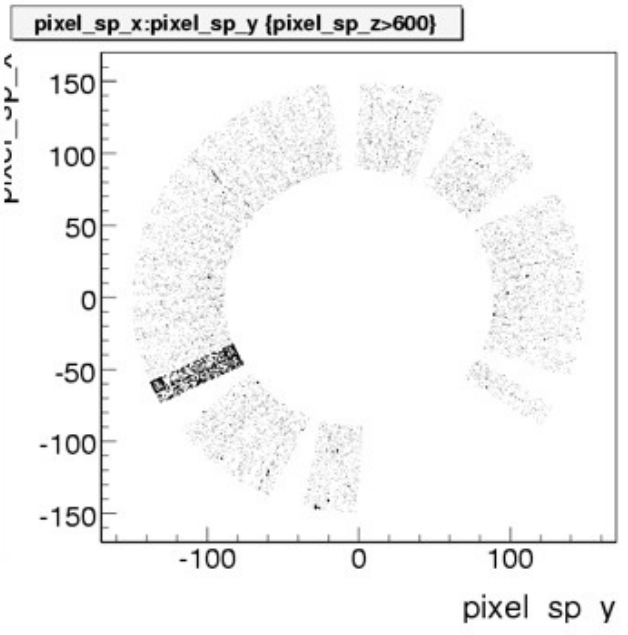


Analysis of cosmic run 1125 (40K events)

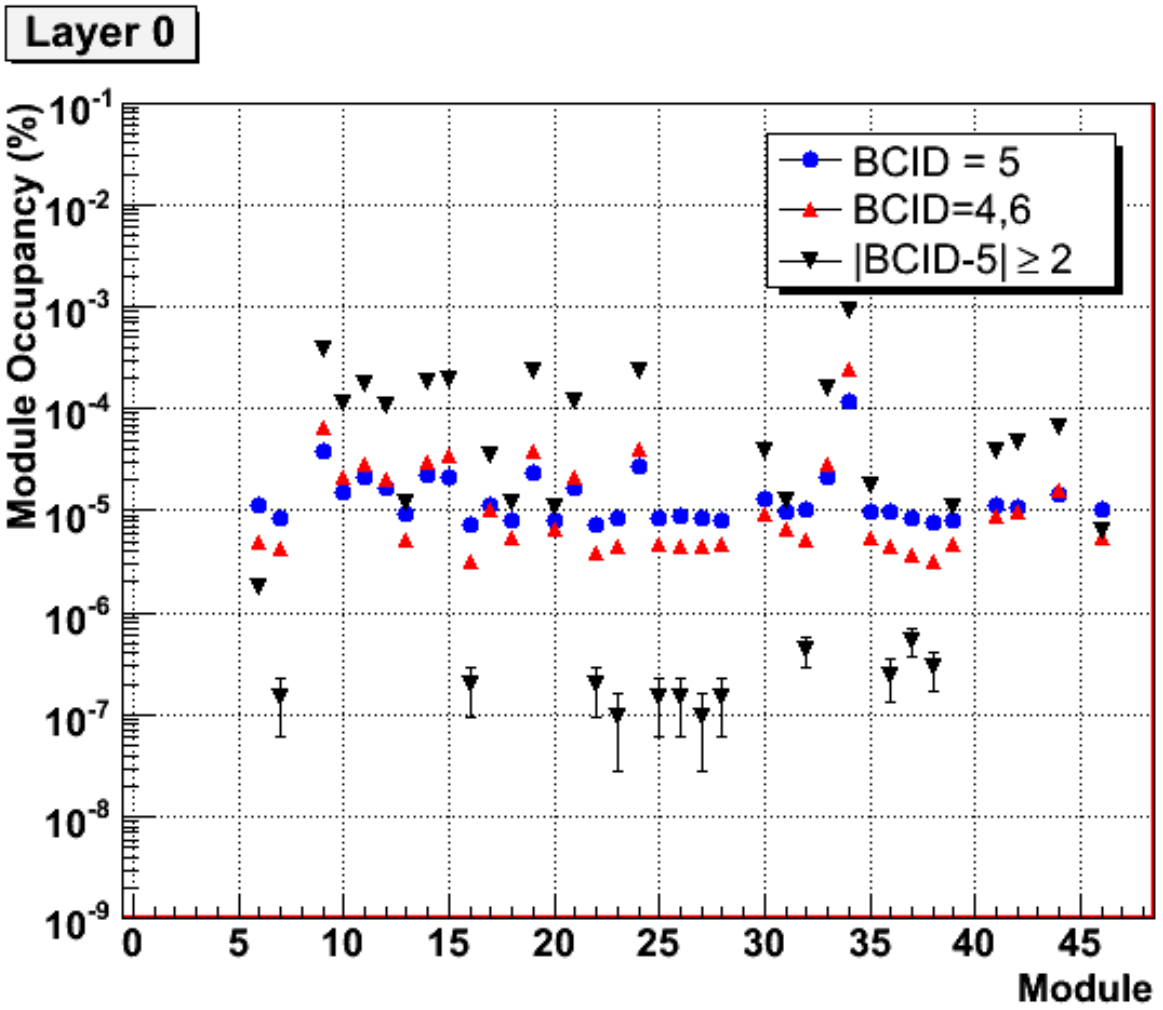
Cosmic tiggered data using SLAC scintillators.





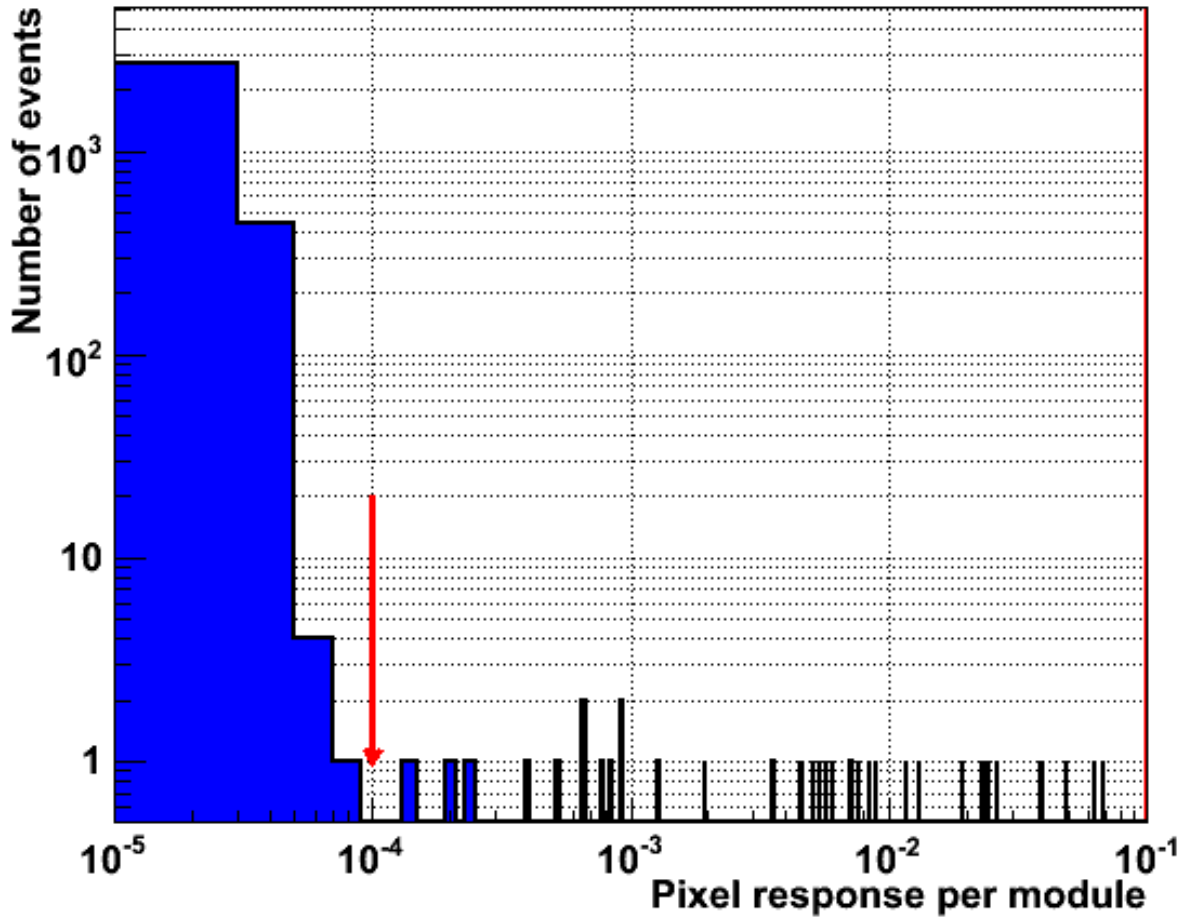


Occupancy (I)



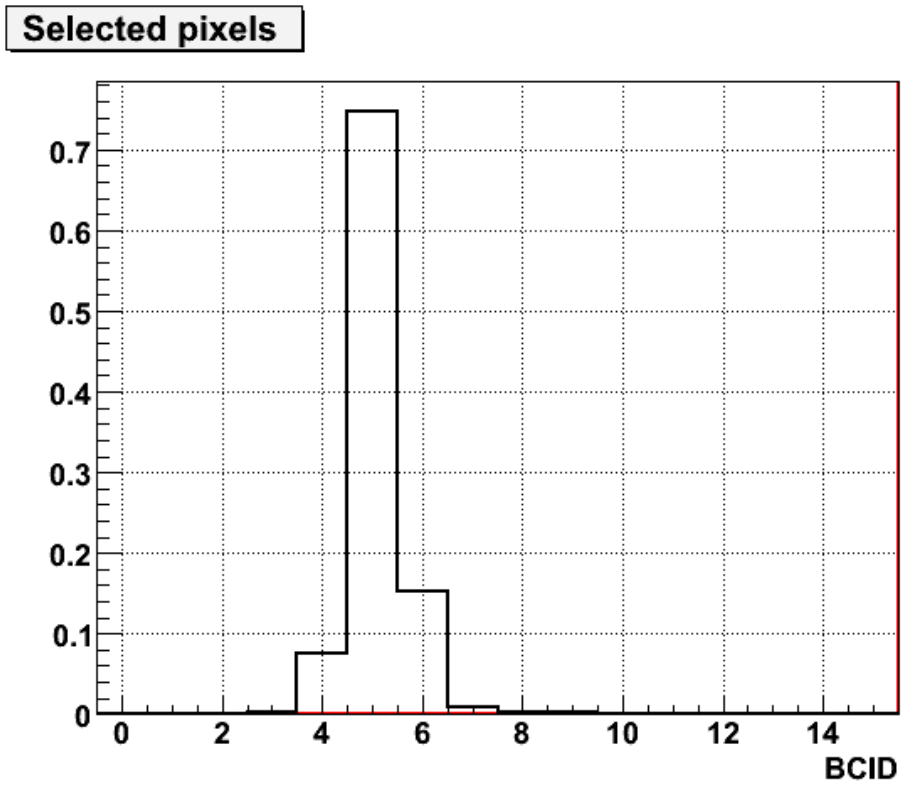
Fraction of pixels readout per module.
Very low occupancy, but large variations among modules, even in events not synchronized by the cosmic trigger (noise)

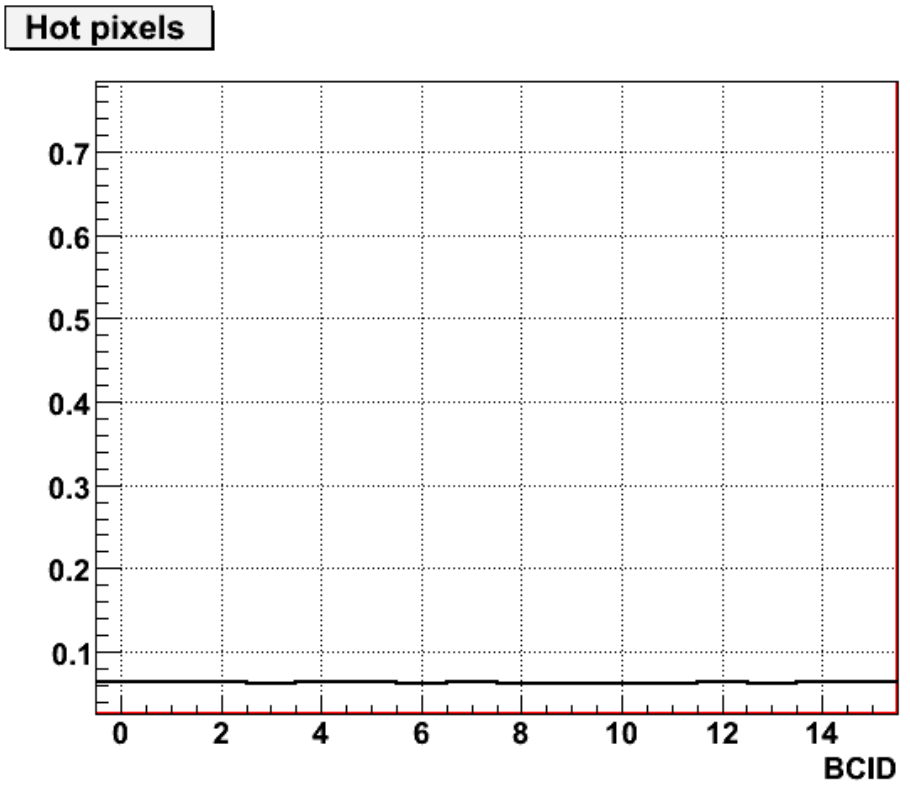
Hot Pixel Studies (I)



Fraction of events that a same pixel fires.
If R>0.0001, pixel is masked as “hot” (1544 hot pixels)

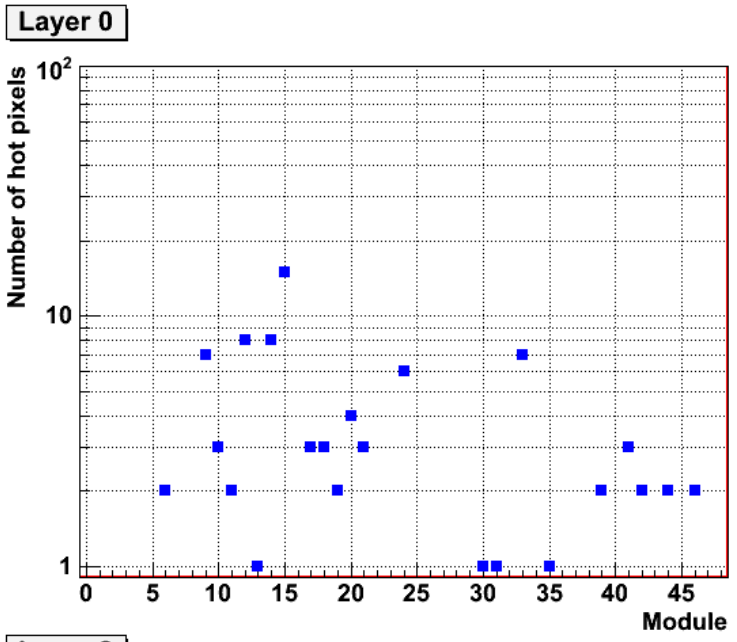
Hot Pixel Studies (II)

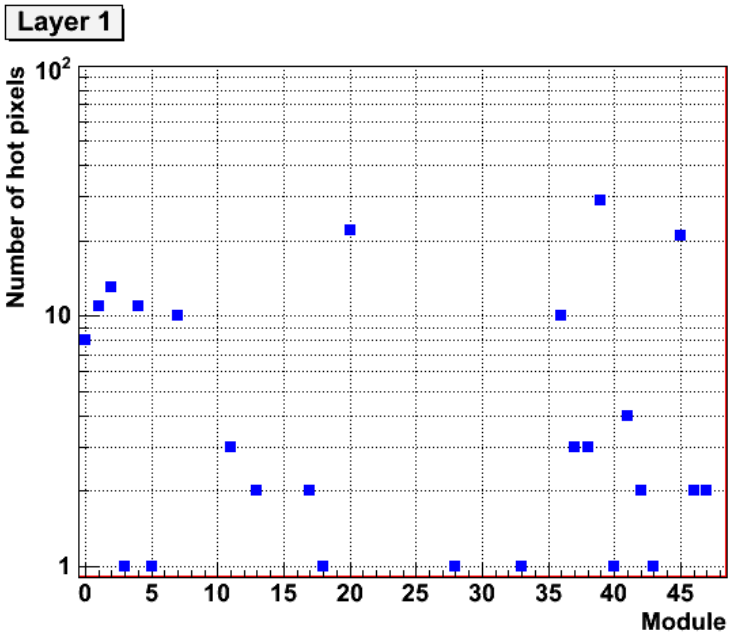


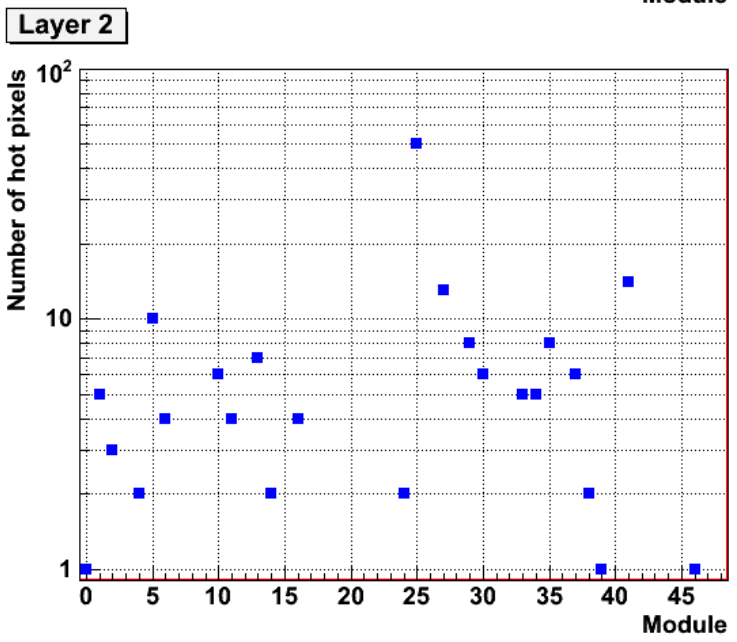


Selected pixels arise from the trigger BC, whereas hot pixels are uniformly distributed in Bcids.

Hot Pixel Studies (III)

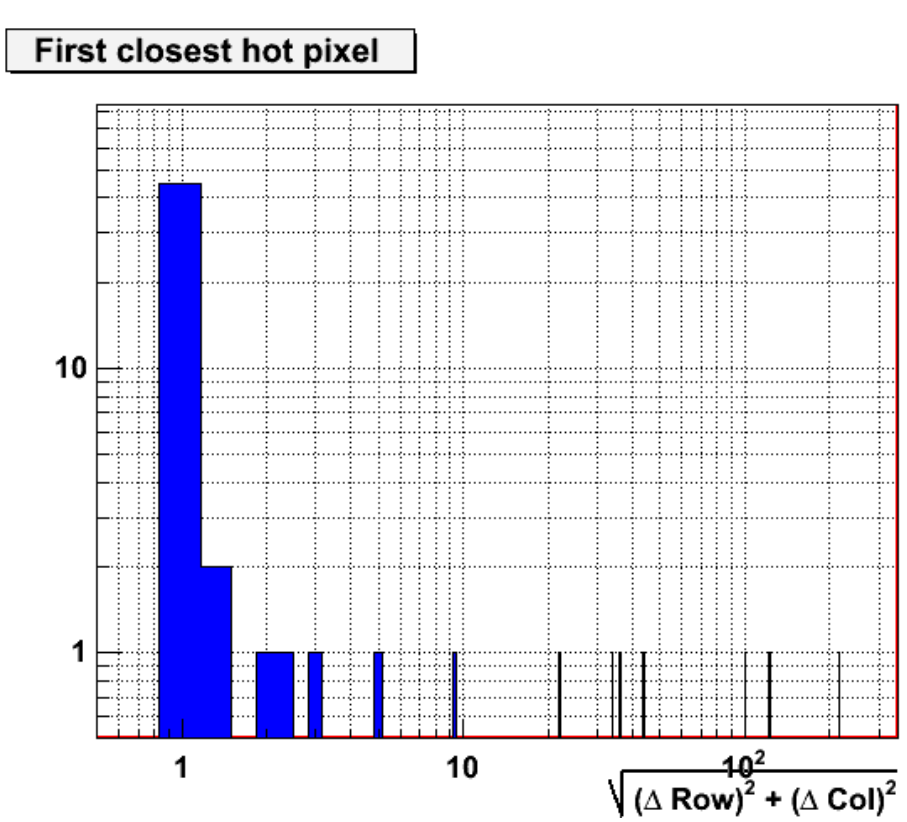


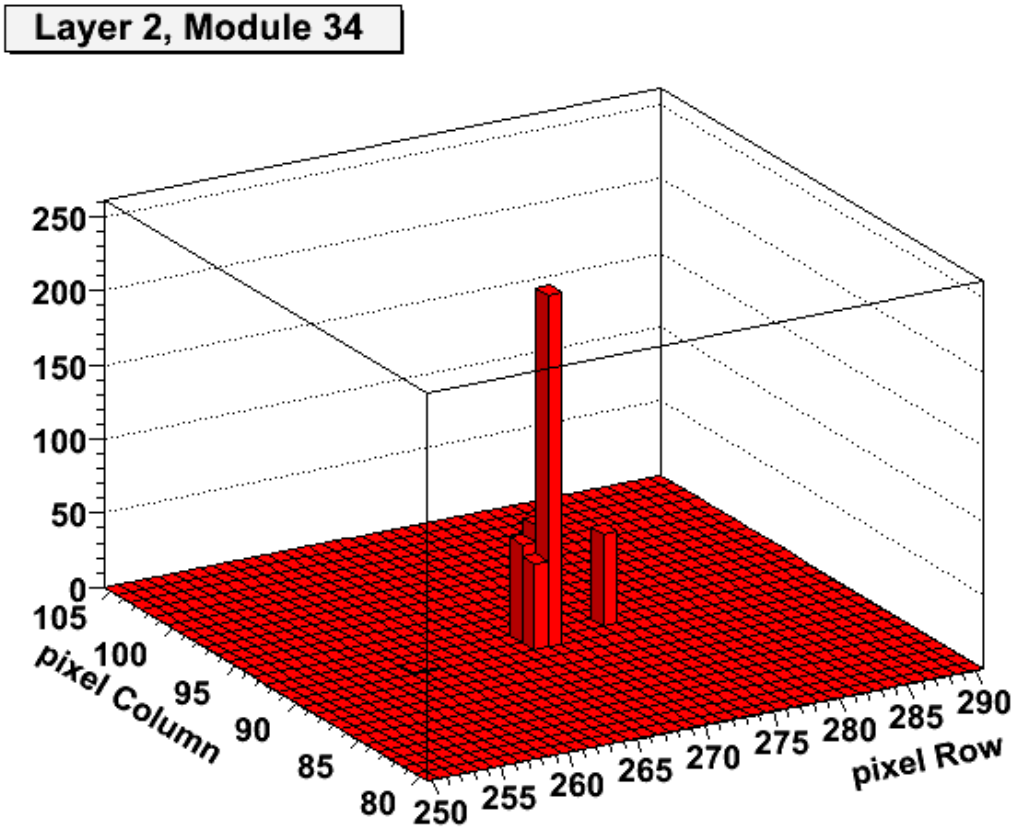




Distribution of number of hot pixels per module, per layer.

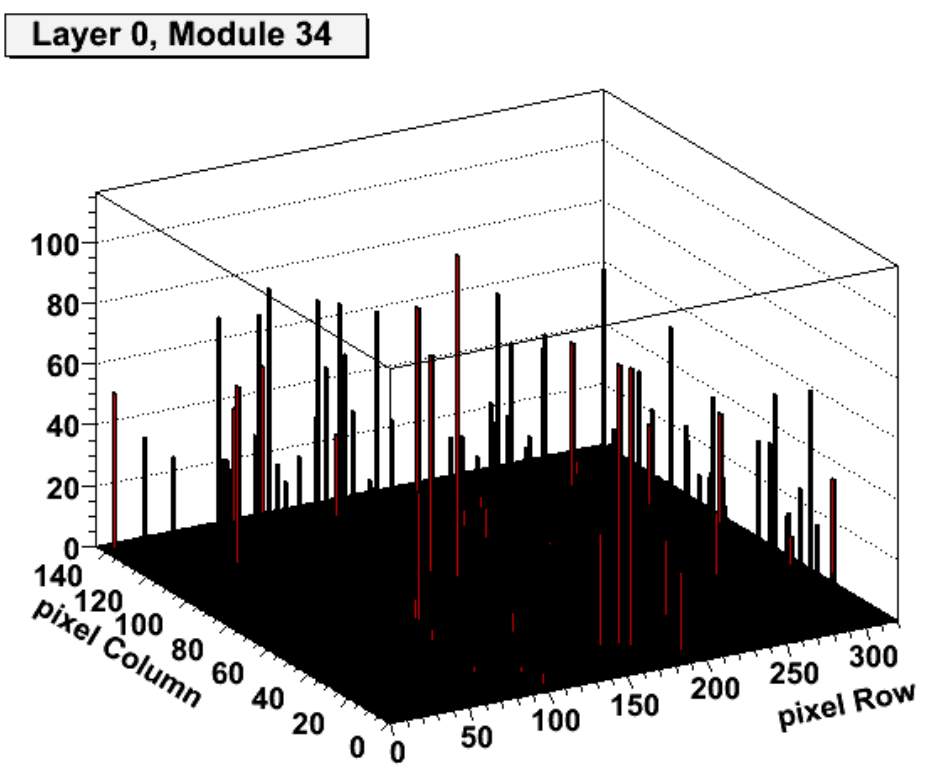
Hot Pixel Topology

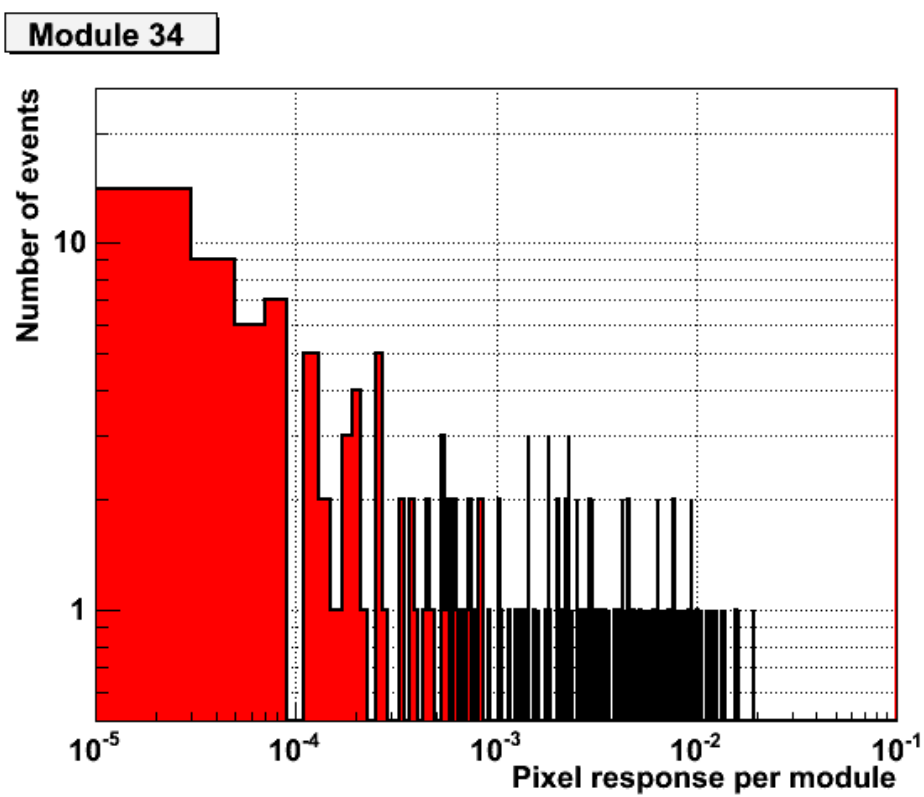




Very often, hot pixels are produced within "regions" involving several nearby pixels.
But not all pixels in the hot-regions fire at the same time.

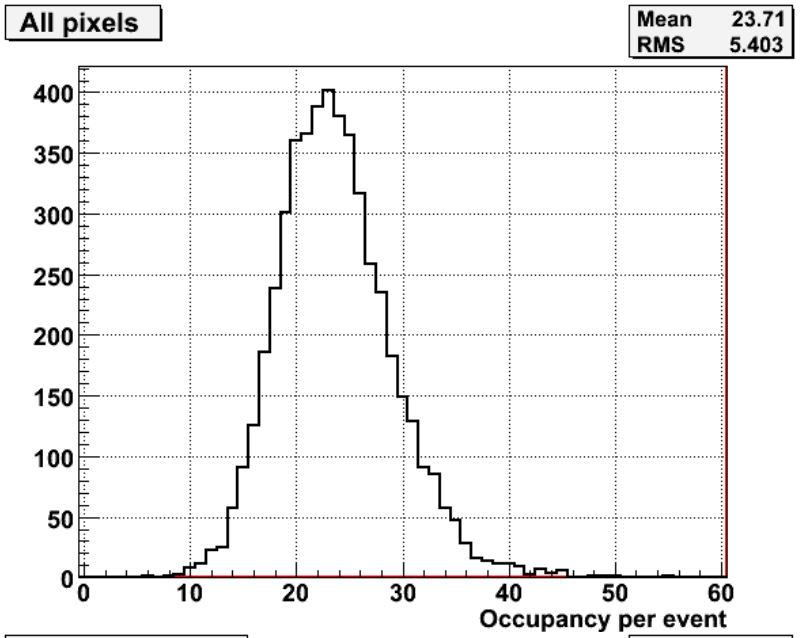
Problematic Modules

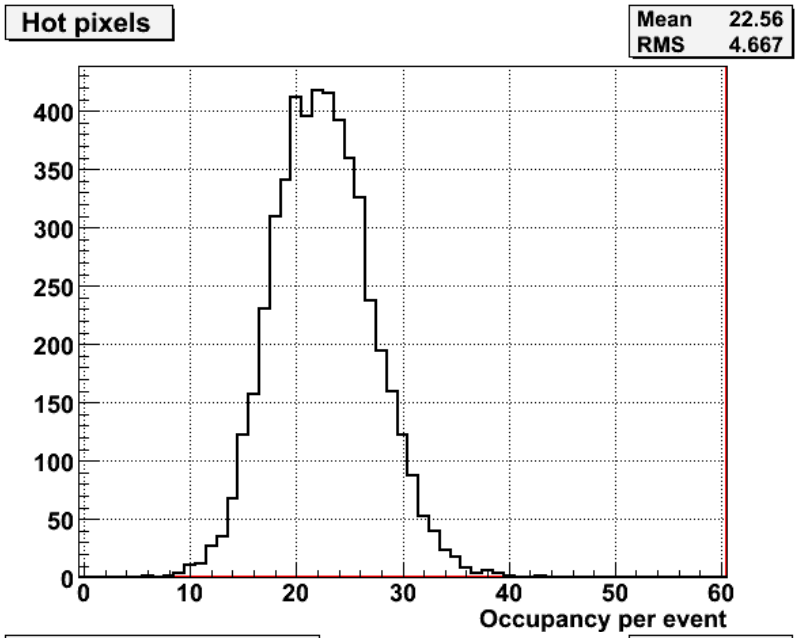


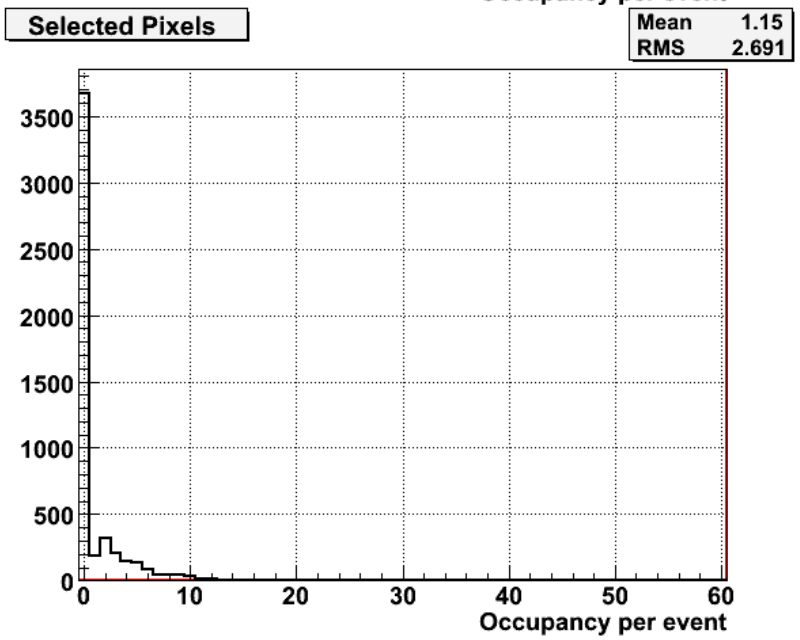


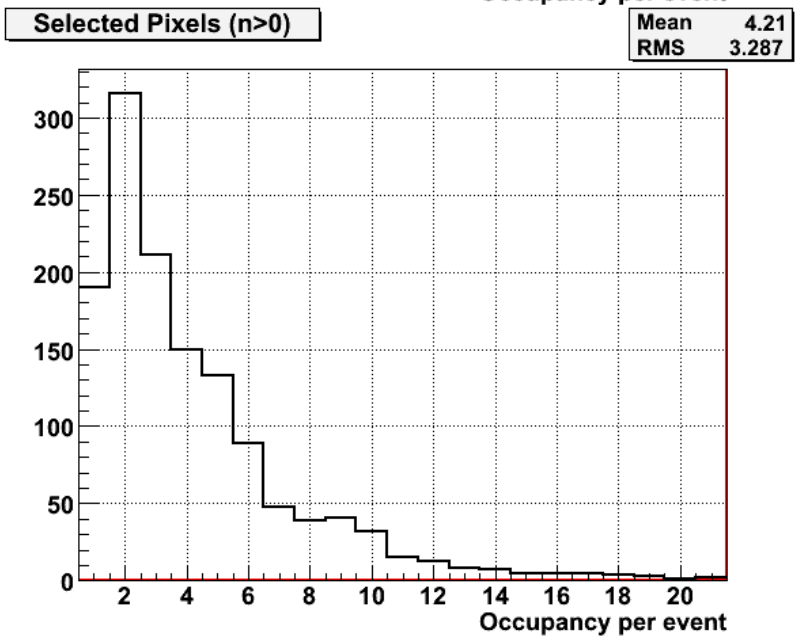
Module 34-L2 shows a different behavior with respect to all other modules: Larger number of hot pixels, almost uniformly distributed among the module.

Hot Pixel Distributions

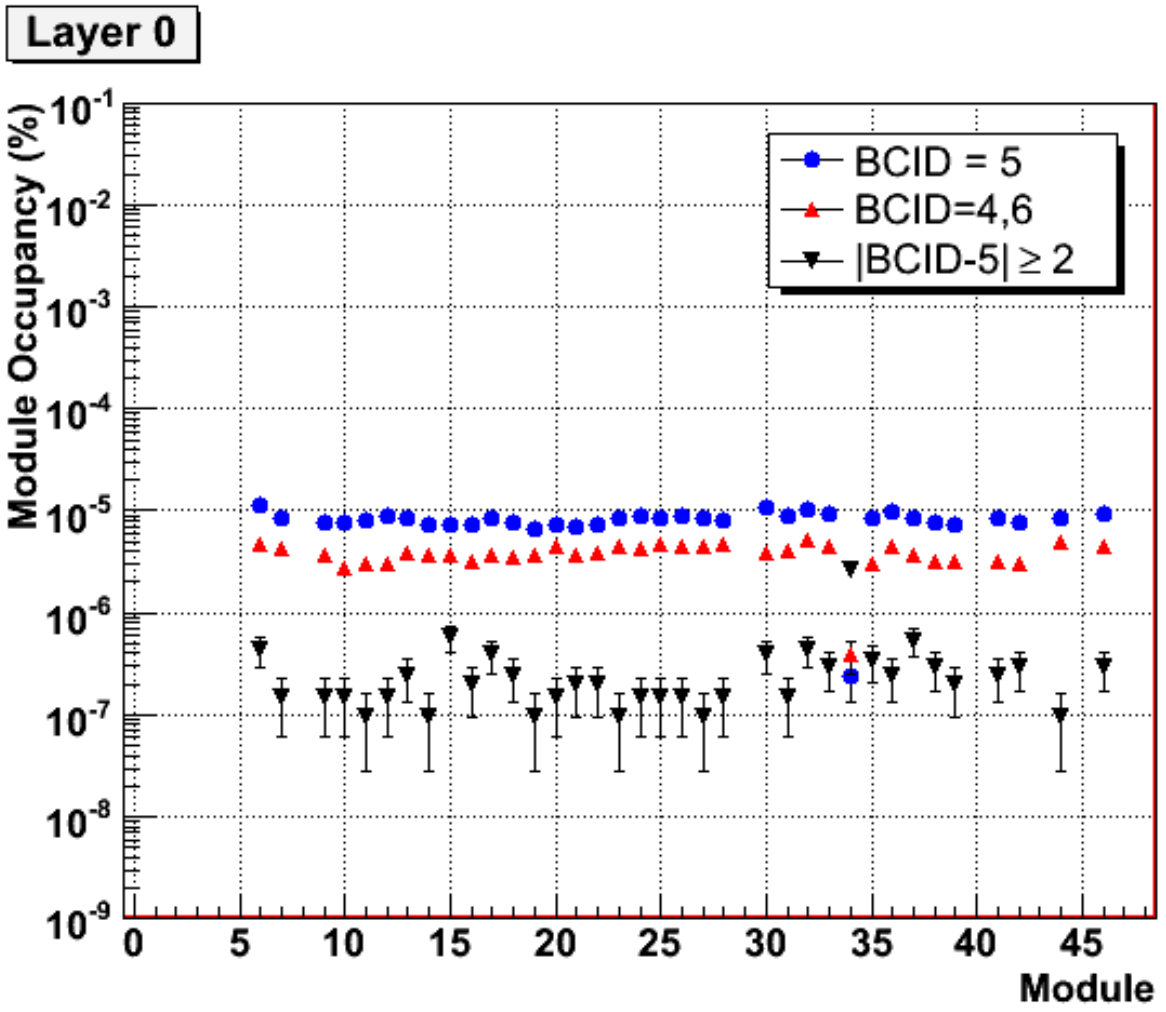








Module Occupancy After Hot-Pixel Cleaning



Low signal for module 34-L2, at the level of noise.

Clustering

Implemented cluster-finder algorithm, to be used after hot-pixel cleaning:

1st pass:

Select seed pixels with |Bcid-5|<=1

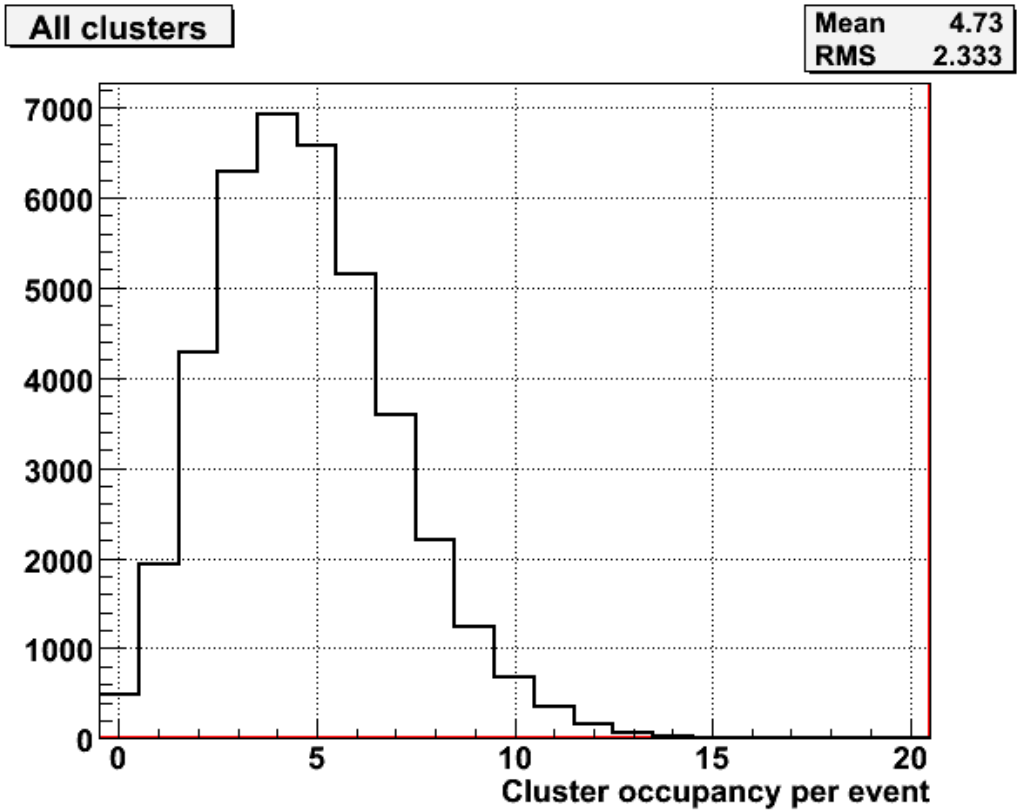
Attach all neighbors pixels if DeltaRow<=1, DeltaCol<=1.

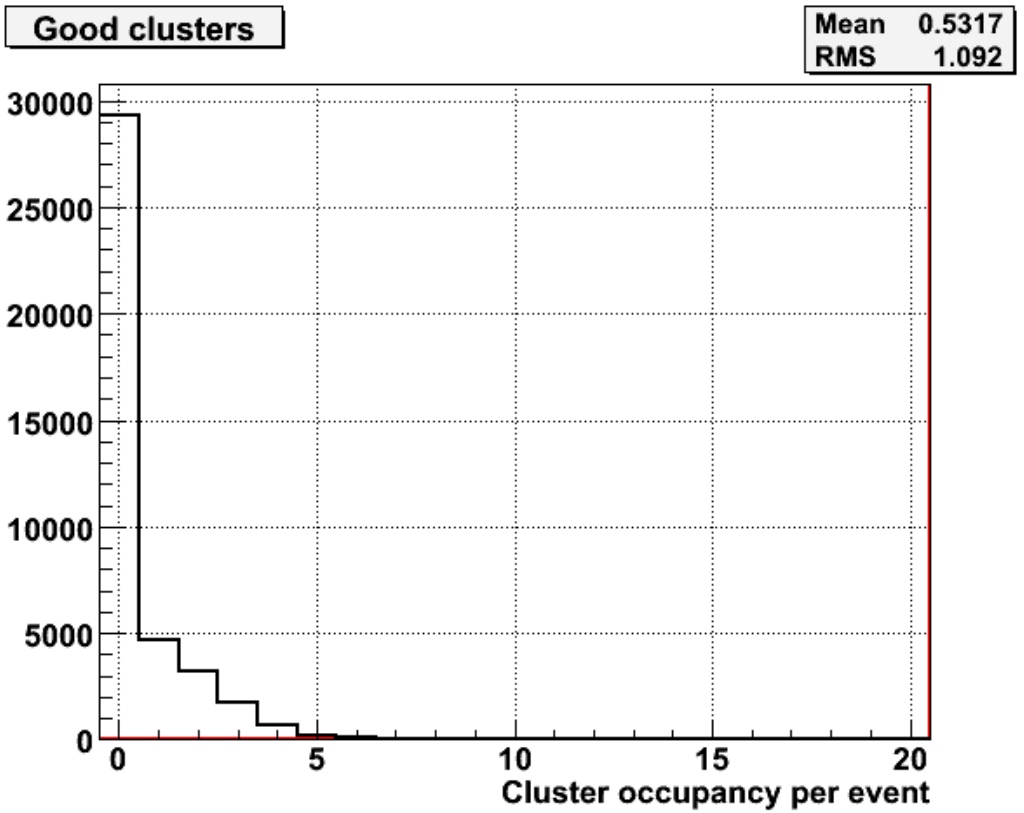
2nd pass:

Merge pre-clusters sharing pixels.

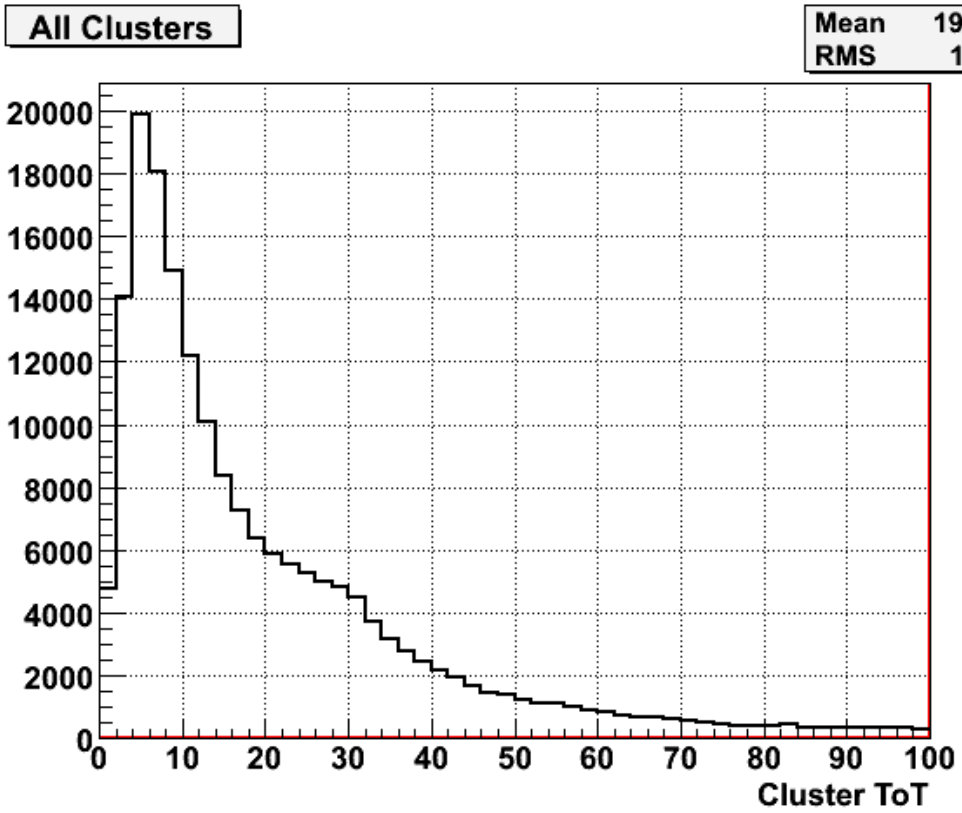
In an event-by-event basis pixels are classified as “hot” or “good”.

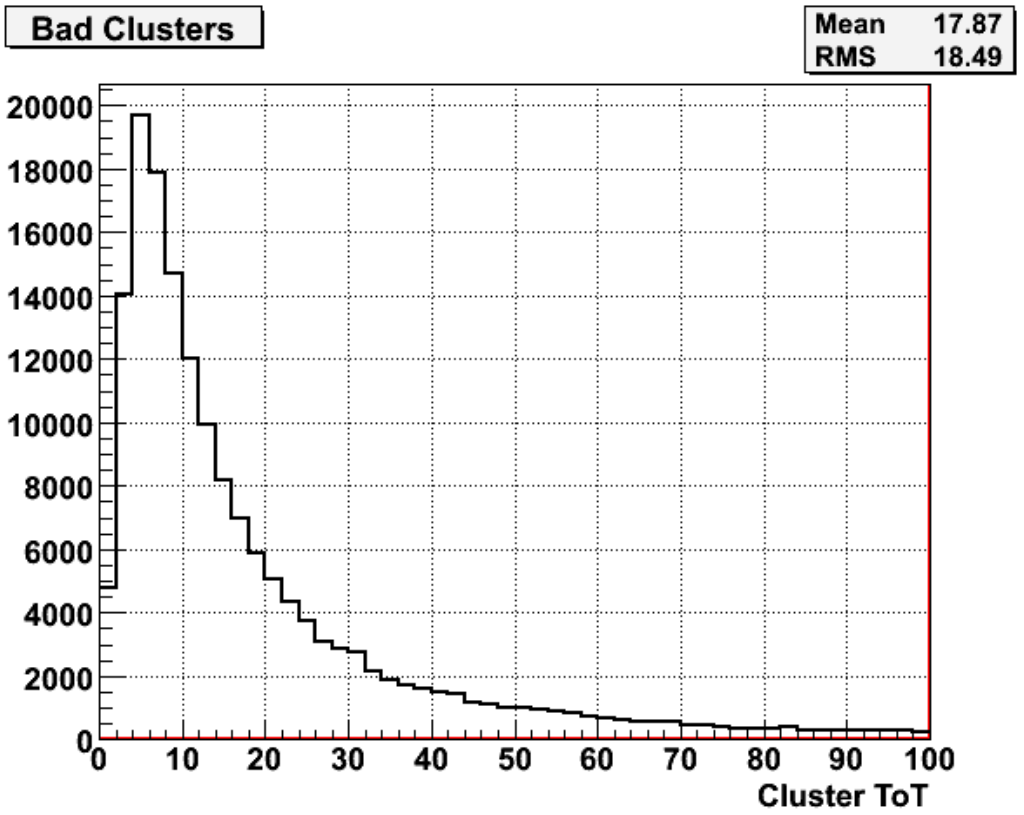
Cluster Occupancy per Event





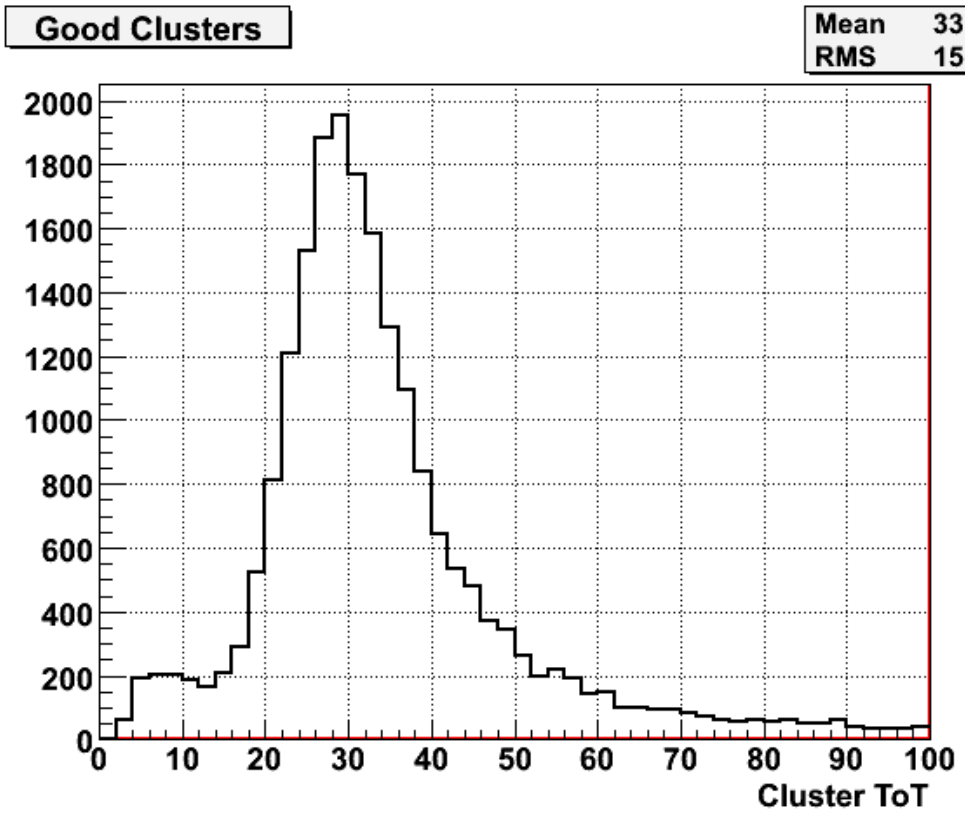
Cluster ToT Distribution (I)

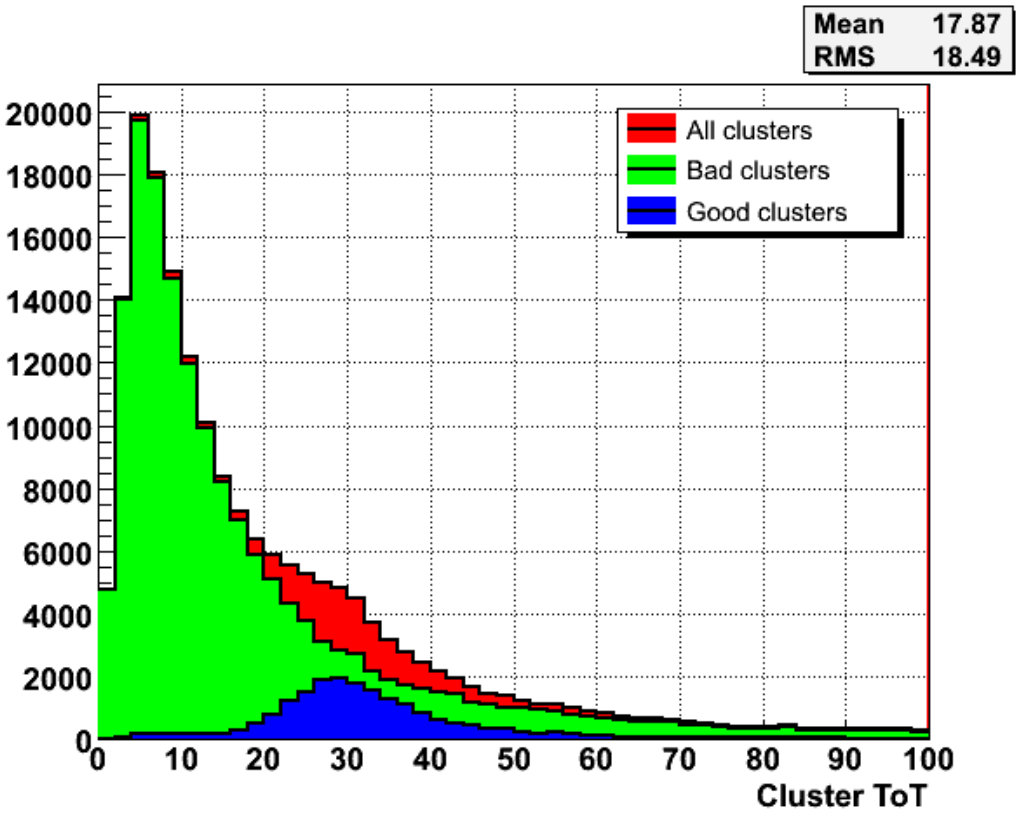




Pixel ToT from signal tracks should peak at ToT=30.

Cluster ToT Distribution (II)

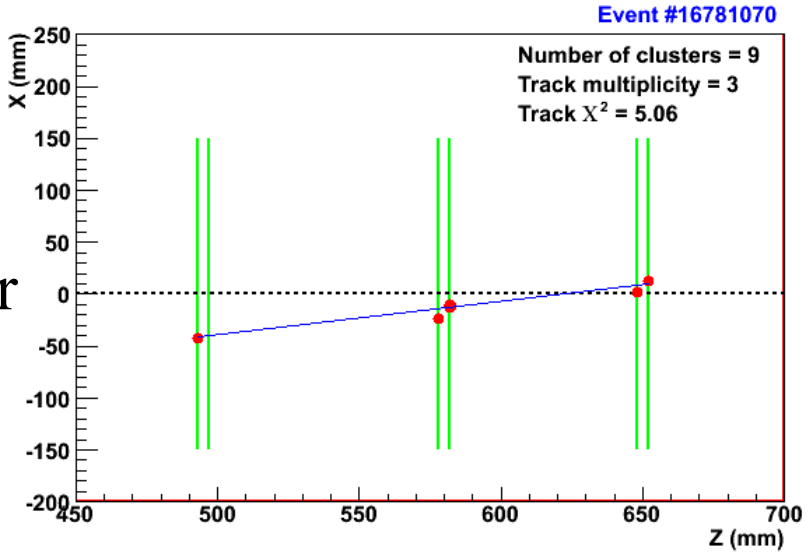




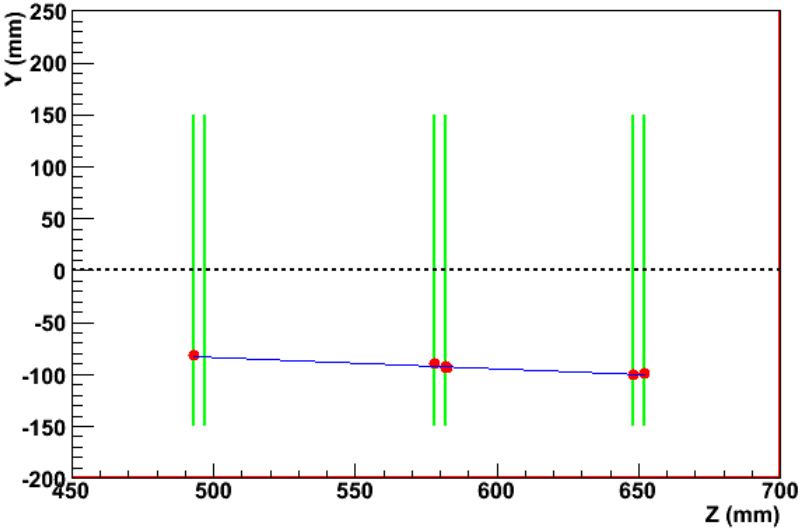
Tracking Studies (I)

Implemented simple track-finder algorithm:

1st pass: select events with at least 1 cluster in each layer.
Form all possible paths, and select the track with the smaller chi2/ndof.

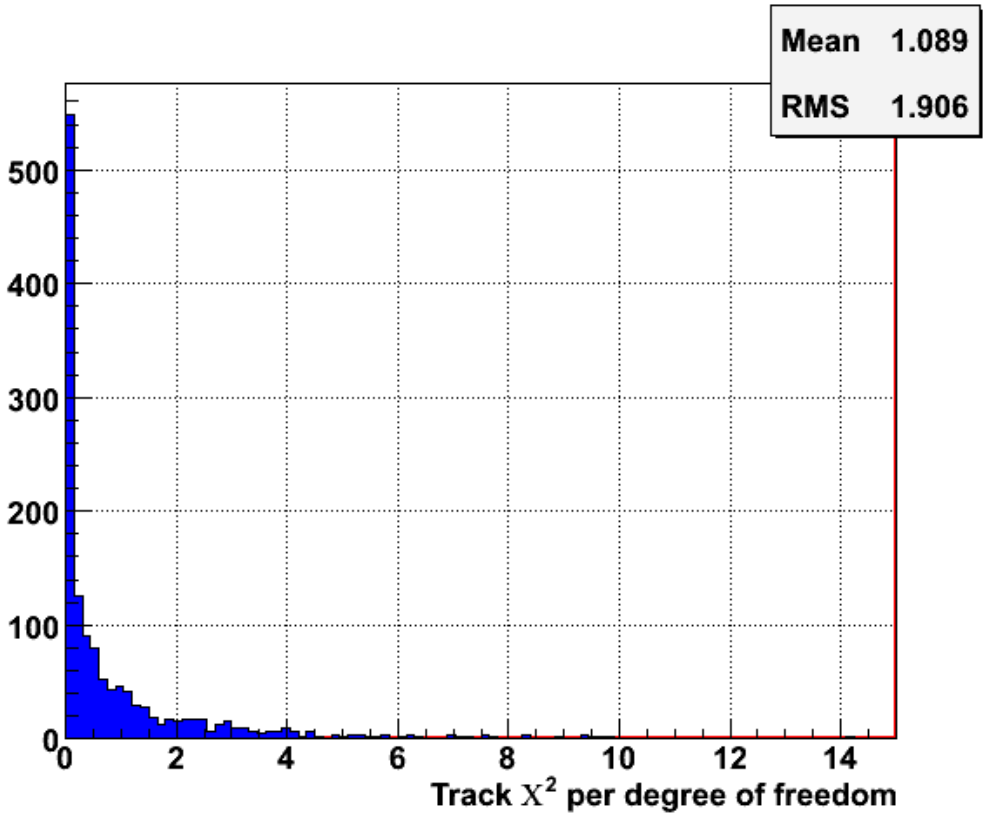


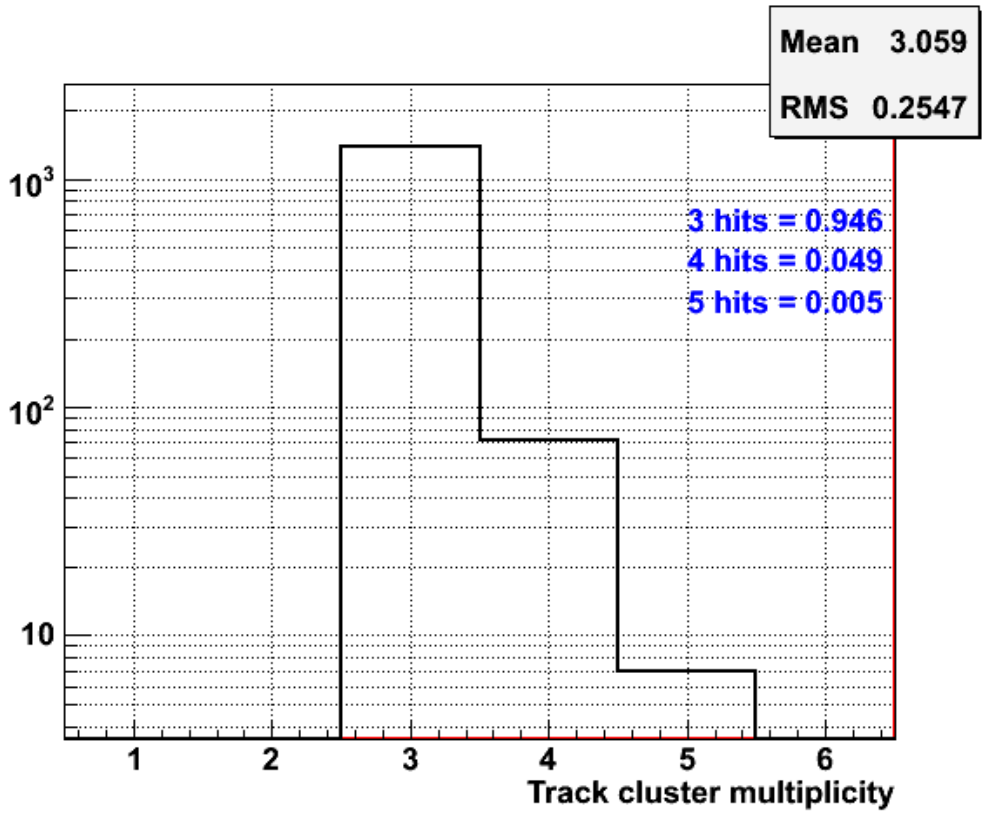
2nd pass: exclude 1 hit at the time and evaluate the change in chi2/ndof of the fit.
Reject cluster if that improves the chi2 of the track.
Iterate until no more clusters can be removed or the number of attached clusters is 3.



Fitting is done with a 3D line parametrization.

Tracking Studies (II)



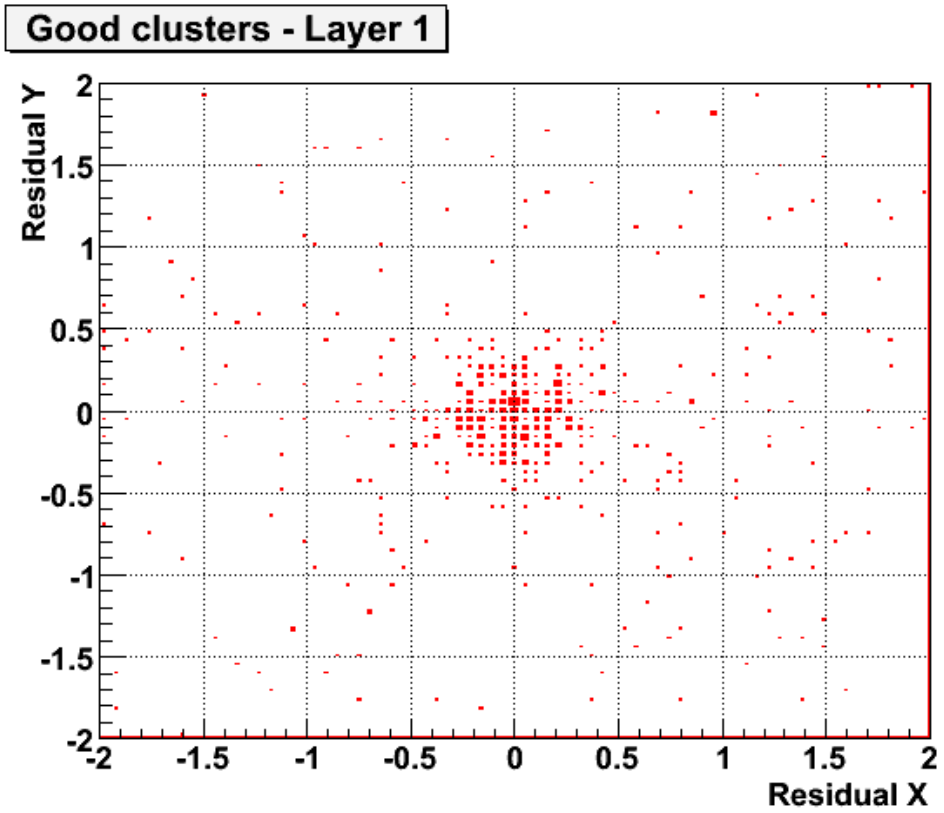


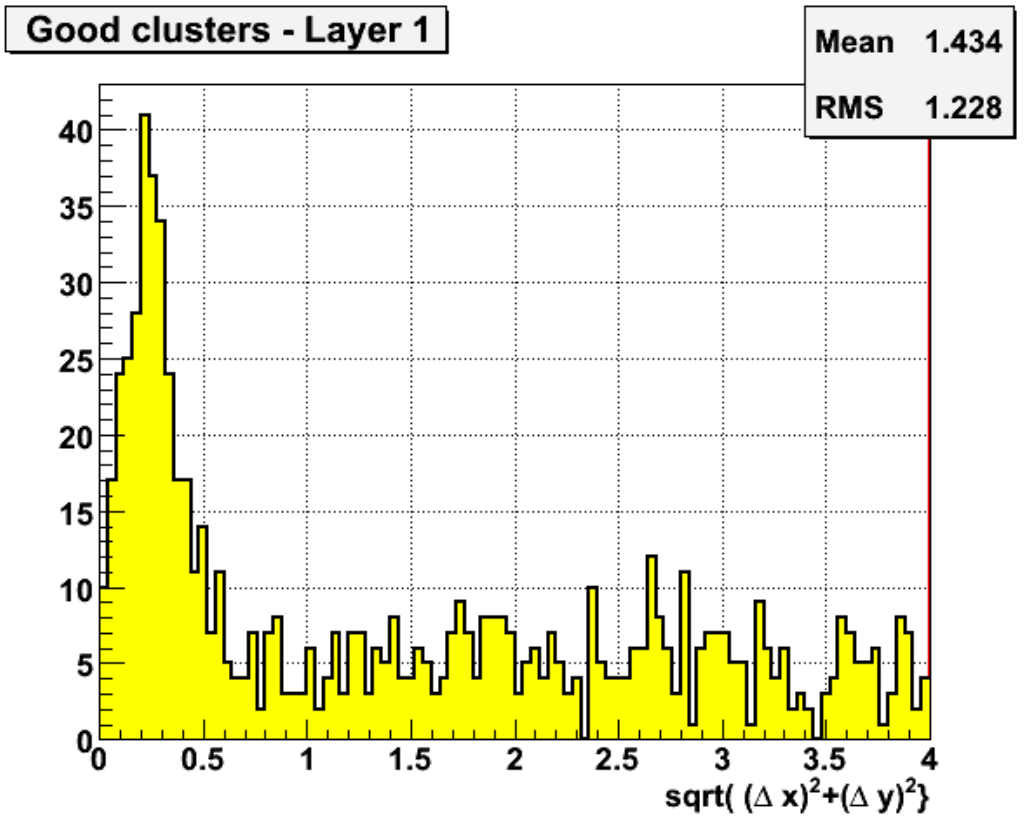
Cluster errors "tuned" to 3.3mm, so that chi2 mean value is 1.

Very low fraction of 4-hit tracks (5%, expected ~15-20%)

Extremely large cluster error needed.

Tracking Studies (Resolution)



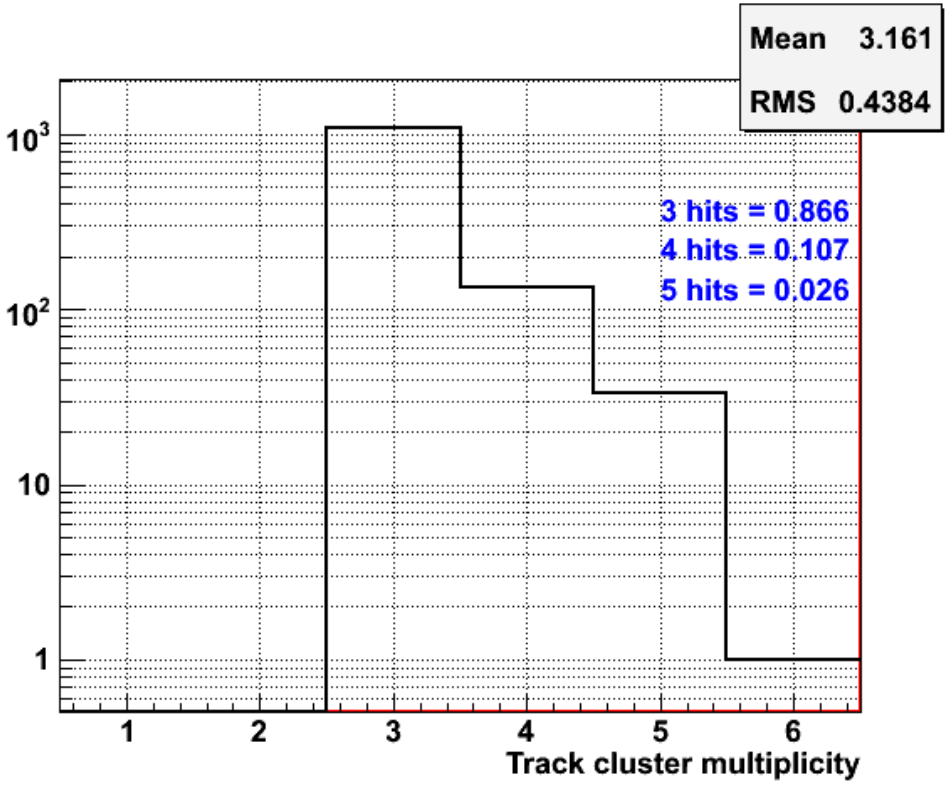


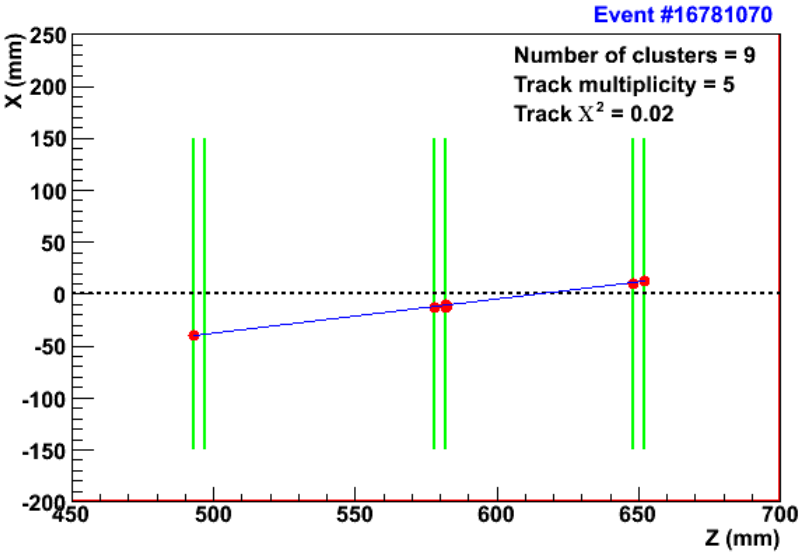
Form track with 1 cluster in each layer, remove cluster in middle layer, re-fit track, and compute resolution as the difference between the cluster position at layer 1 and the track prediction.
Very large tails -> geometry problem (see Su Dong's talk)

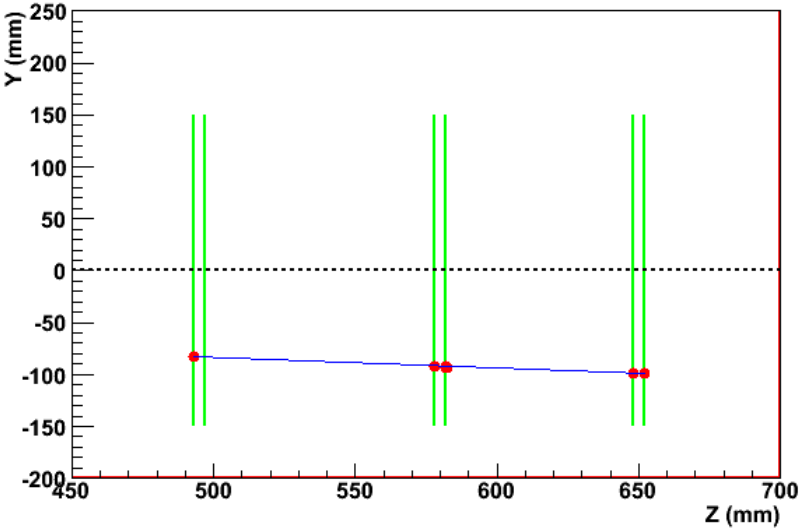
Tracking with Fixed Geometry

Results using new geometry
(phi flip between front/back modules in a same layer)

Resolutions are now close to 50um.



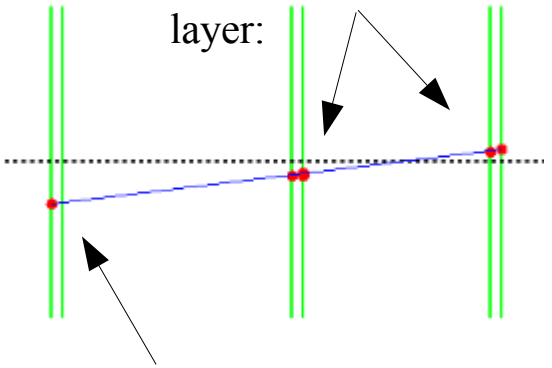


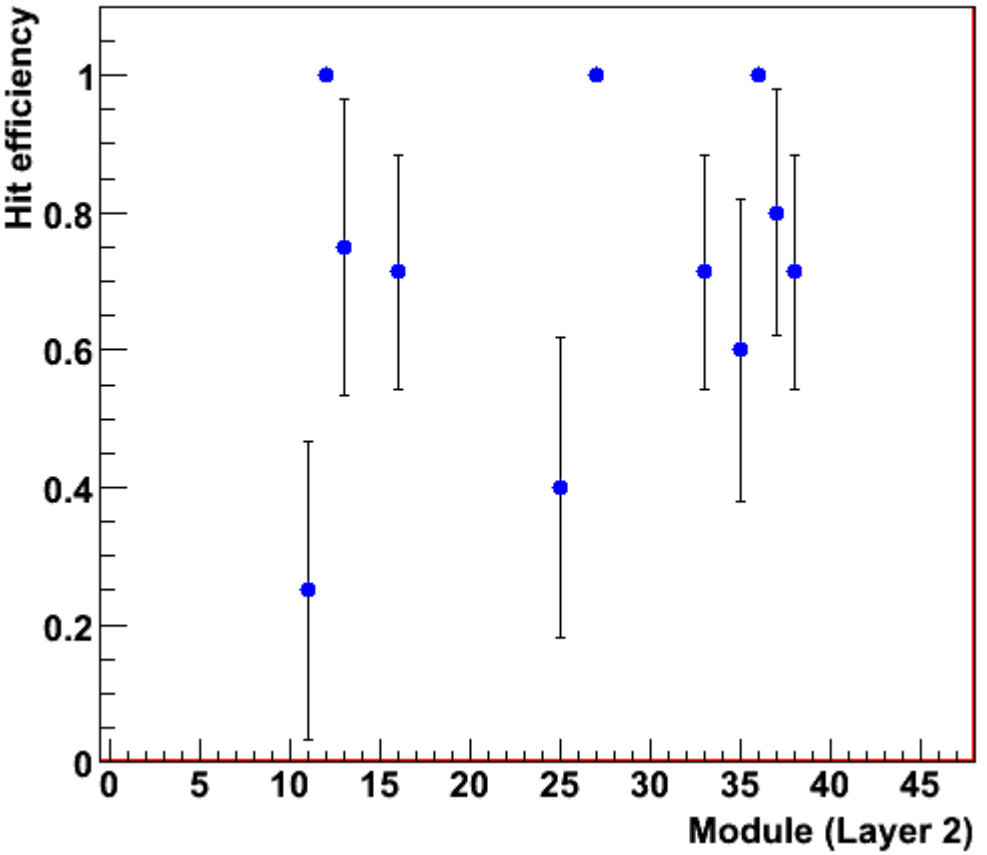


Module Hit Efficiency

Look for tracks with at least one doublet, and 1 cluster in a second layer. Form track, extrapolate to the 3rd layer, and compute an unbiased module cluster efficiency. Take into account module acceptance.

Very first look. Need to process more events (~5 entries per module)





Summary and Plans

First look at data from cosmics run:

- Very low noise (module occupancy ~ 10^{-7})
- Hot-pixels seems to be clustered in regions. Need further investigation.
- Tracks found after geometry fix, and hot-pixel removal.
  - ToT cluster distribution and number of overlapping clusters in tracks consistent with expectation.
- Very first look at module efficiencies. Work in progress.